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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Pironti, et al.

Application No.: 09/839,759

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Examiner: Nguyen, T.

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Docket: 1085-2 RCE

Date: April 24, 2003

For: ETHANE EXTRACTION PROCESS FOR A HYDROCARBON GAS STREAM

I hereby certify this correspondence is being deposited with United States Postal Service as first class mail, postpaid in an envelope, addressed to: Commissioner of Patents, Washington, D.C. 20231,
on April 28, 2003
Signature K.J. Goodhand K J Goodhand

BOX Non-Fee Amendment
Commissioner for Patents
Washington, DC 20231-0001

DECLARATION OF FILIPPO PIRONTI PURSUANT TO 37 C.F.R. §1.132

Sir:

1. I am a co-inventor of the subject matter of U.S. Patent Application No. 09/839,759 entitled "Ethane Extraction Process For A Hydrocarbon Gas Stream". The declaration is submitted in response to the Office Action, dated January 30, 2003. I am making this declaration in support of the patentability of the claimed invention.

2. By way of background, I have a Ph. D. in chemical engineering from Cornell University, Ithaca, N.Y., obtained in 1971, and a B. Sc. in chemical engineering from Universidad Central de Venezuela, Caracas, Venezuela, obtained in 1964. I have experience on several NGL extraction and fractionation projects, including conceptualization, basic engineering, detail engineering and operations follow up of NGL plants, Propane-Propylene Splitter Plant and Ethane Extraction Plant. I have been employed since 1997 by INELECTRA S.A.C.A. Caracas, Venezuela, and I have been a consulting engineer for other engineering companies since 1972 prior to my employment by INELECTRA S.A.C.A. INELECTRA S.A.C.A. has several divisions, one of which is engineering and construction, including the engineering and construction of hydrocarbon gas processing projects.

3. I have read the Examiner's Office Action dated January 30, 2003 including the Examiner's rejection of the claims therein. I have studied U.S. Patent No. 6,125,653, entitled "LNG With Ethane Enrichment And Reinjection Gas As Refrigerant", to Shu et al. (hereinafter "Shu") which has been cited by the Examiner against my invention under 35 U.S.C. §103(a). I believe that Shu does not render my invention unpatentable. My reason for this conclusion is that Shu fails to teach or suggest the present invention.

4. Shu is directed to the recovery of liquefied natural gas by cooling a gaseous hydrocarbon feed stream in a turbo-expander to provide a cooled and substantially gaseous feed to a de-methanizer distillation column. Shu requires that the cooled feed exiting the turbo-expander be preferable at a temperature of -89°F. Such a cold temperature is typical for the separation of methane from heavier hydrocarbons in a de-methanizer distillation column.

5. Shu describes that the gaseous hydrocarbon feed for his process is available at ambient temperature of about +110°F and at a pressure of about 1,800 to 2,000 psig. The feed of Shu, as described in Table 1 therein, has about 87.4% molar methane, 11.7% molar ethane, and 0.9% molar propane. I have calculated the feed composition by the mass balance and process operating conditions shown on Table 1 of Shu's patent. In Shu's process, the feed is expanded in the turbo-expander by reducing the pressure by a factor of about 4. I have simulated the required process conditions of Shu on HYSYS ver. 3.0.1, and estimate that Shu's Stream No. 2 in Table 1, i.e. the turbo-expander outlet, has 90,773 lbmols/hr of vapor and 14,859 lbmols/hr of liquid. HYSYS is a preferred process simulator for hydrocarbon gas processing, is well known for those ordinary skills in the art of simulating gas processes, and is commercially available.

6. My present invention as set for in the subject application is directed to the recovery of ethane from a hydrocarbon gas steam having from about 50 % to about 75 % by mole methane, from about 15 % to about 40 % by mole ethane and from about 1 % to about 4 % by mole propane. This feed stream is cooled in a cryogenic heat exchanger without external refrigeration, for example without propane or ethane refrigeration, and without turbo-expansion of the feed, all of which are required by Shu. The feed of my invention exits the cryogenic heat exchanger as a condensed sub-cooled liquid and no de-methanizer overhead condenser is used as required in Shu's patent. Thus, the condensed sub-cooled liquid feed of my invention exiting the cryogenic heat exchanger is in direct contrast to Shu's stream No. 2 whose cooling produces a cooled feed stream being only 14% mole liquid.

7. Moreover, I have simulated the feeds of my present invention under the process requirements of Shu, and found the process of Shu to be strongly limited, if not inoperable, to handle such heavier feeds. Simulations were carried out with our lightest feed above, i.e. 75 % mole methane, 24 % mole ethane and 1 % mole propane, and with our heaviest feed above, i.e. 56 % mole methane, 40 % mole ethane and 4 % mole propane. The lowest temperature that can be achieved in a precooled gas feed such that a turbo-expander can be operable is +53°F for the lightest feed of my invention and +83°F for the heaviest feed of my invention. Furthermore, with our feeds above, Shu's requirement that the cooled feed exiting the turbo-expander be at a temperature of -89°F cannot achieved. A turbo-expander outlet temperature of only -56°F is

obtained with the lightest feed above and of only -16°F with the heaviest feed above. Thus, Shu would require additional external refrigeration, such as propane or ethane refrigeration, to obtain its required temperature of -89°F. Without obtaining the required temperature, the recovery system of Shu would not adequately operate, i.e., the de-methanizer would not be cold enough to adequately separate methane from the heavier hydrocarbons or a prohibitively larger de-methanizer overhead condenser would be required.

8. In summary, Shu's process purpose of extracting ethane from our feed gas stream is not self-sustainable from the energy point of view when dealing with heavier and/or lower pressure feeds. The total required external cooling or refrigeration duty, such as cooling duties in Shu's demethanizer overhead condenser, de-ethanizer overhead condenser and recycle methane cooler, increases by two times for the lightest feed and up three times for the heaviest feed above, while the available turbo-expander would not change appreciable. This leads to a prohibitive increase of additional energy for the purpose of external refrigeration and defeats the very purpose of Shu by requiring such additional external refrigeration. Thus, the process of Shu would be inoperable with the feed of the present invention.

9. For these reasons, I believe that my ethane recovery process is patentably distinct from the process of Shu.

10. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

Dated this 24 day of April, 2003

Filippo Pironti